Page 19, line 6: Change "multiplexer" to -demultiplexer-.

Page 19, line 16: Change "multiplexer" to -demultiplexer-.

Page 23, line 3: Change "multiplexer" to -demultiplexer-.

Page 30, line 6: Change "pick-up plate" to -pickup electrode-.

In the claims please substitute the following claims 1, 2, 4, 5, 6, 8-12, 15-19, 21, 22, 24-37, 39, 41-57 for the claims 1, 2, 4, 5, 6, 8-12, 15-19, 21, 22, 24-37, 39 previously in the application. Please delete claims 13 and 14.

1. A precision multi-dimensional capacitive transducer comprising:

pickup electrode means comprising a center electrode assembly including a center electrode and a plurality of support springs engaging and supporting said center electrode, said support springs comprising planar springs;

a plurality of drive plates disposed on opposing sides of said pickup electrode means, said drive plates comprising an electroconductive material disposed on an aluminum oxide substrate;

means for supporting said drive plates.

2. The capacitive transducer of Claim 1 wherein said drive plates comprise eight plates, four of said plates being disposed on each side of said center electrode.

4. The capacitive transducer of claim 3 wherein said center electrode comprises a planar electrode and said support springs lie on the same plane as said center electrode.

5. A precision Multi-dimensional capacitive transducer comprising:

a lower drive plate electrode assembly, said lower assembly including a plurality of drive plates, said drive plates being composed of electrically conductive material disposed on an aluminum oxide substrate;

an upper drive plate electrode assembly, said upper assembly including a plurality of drive plates, said drive plates being composed of electrically conductive material;

a center electrode assembly including a center electrode and a plurality of support springs engaging and supporting said center electrode, said support springs comprising planar springs;

said lower drive plate electrode assembly and said upper drive plate electrode assembly being disposed on opposing sides of said center electrode.

6. The capacitive transducer of Claim 5 wherein each of said upper and lower drive plate electrode assembles include four plates.

8. The capacitive transducer of claim 5 wherein said center electrode and said support springs of said center electrode assembly lie in a single plane.

9. The capacitive transducer of Claim 8 wherein said center electrode assembly comprises metal foil.

10. The capacitive transducer of Claim 9 wherein said metal foil of said center electrode assembly comprises high strength beryllium copper alloy.

11. The capacitive transducer of Claim 10 wherein said center electrode assembly is formed from a single sheet of foil.

12. The capacitive transducer of Claim 10 wherein said center electrode assembly is formed from a single sheet of foil by photochemical etching.

Delete Claim 13.

Delete Claim 14.

15. The capacitive transducer of Claim 11 wherein said electrode assembly comprises a material having a thermal expansion coefficient similar to aluminum oxide.

16. The capacitive transducer of Claim 15 wherein said electrode assembly material is molybdenum.

17. The capacitive transducer of Claim 9 wherein said transducer includes first spacer means disposed between said lower drive plate electrode assembly and said center electrode assembly and a second spacer means disposed between said upper drive plate electrode assembly and said center electrode assembly.

18. The capacitive transducer of claim 17 wherein drive plate electrodes of said drive plate electrode assemblies comprise copper foil having a thickness in the range of 0.0005 and 0.005 inches.

19. A precision Multi-dimensional capacitive transducer comprising:

a plurality of drive plates, said plates being composed of electrically conductive material;

pickup electrode means movably mounted relative to said drive plates;

further including: electrical circuit means for applying electrical drive pulses to said drive plates, said drive plates being operatively grouped into pairs, said pulses having a frequency F, and a pulse width T of approximately 1/F divided by the total number of drive plates, said drive pulses being grouped into one main channel per operative drive plate pair, each main channel consisting of two sub-channel pulses, one sub-channel pulse of said main channel operative on a first drive plate of said drive

plate pair, with remaining sub-channel pulse of said main channel simultaneously operative on remaining drive plate of said drive plate pair, with said main channels being multiplexed to sequentially apply said pulses to said drive plates with each main channel dedicated to a particular drive plate pair, and with said main channels being spaced apart in time by approximately the pulse width T;

sampling means for synchronously demodulating and demultiplexing the signal on the pickup electrode means into one channel per drive plate pair, each channel consisting of two sub-channel signals, each channel operatively associated with a particular drive plate pair;

timing means for controlling said sampling means such that each first sub-channel is sampled during the time period that the drive pulse is applied to the corresponding drive plate pair and each second sub-channel is sampled after the drive pulse corresponding to that drive plate has ended, and before the drive pulse corresponding to the next channel in said multiplexed sequence is applied;

storage means for each sub-channel; and

differential amplifier means to convert each of the sub-channel signal pairs into single main channel signals.

21. The capacitive transducer of Claim 19, wherein said drive plates comprise eight plates, further comprising:

electrical circuit means summing all four main channel signals together, said summed signal constituting the Z-axis output signal;

electrical circuit means generating the difference of two of said main channels, said difference signal constituting the X-axis output signal; and

electrical circuit means generating the difference of the two main channel signals not used to generate the X-axis output, said difference signal constituting the Y-axis output signal.

22. The capacitive transducer of Claim 19, wherein each of said main channel signals generated by said differential amplifier means are connected to feedback circuit means which produce feedback signals which control the amplitude of the drive plate pulses in response to displacement of the pickup electrode means relative to the drive plates, such that the induced voltage on the pickup electrode means is forced to zero, and the feedback signals generated by said feedback circuit means are proportional to the displacement of the pickup electrode means relative to the drive plates.

24. The capacitive transducer of Claim 22, wherein said drive plates comprise eight plates, further comprising:

electrical circuit means summing all four feedback signals together, said summed signal constituting the Z-axis output signal;

electrical circuit means generating the difference of two of said feedback signals, said difference signal constituting the X-axis output signal; and

electrical circuit means generating the difference of the two feedback signals not used to generate the X-axis output, said difference signal constituting the Y-axis output

signal.

25. In an optical microscope apparatus having a sample stage providing X-Y motion, focusing means providing Z-axis motion and a multi-position objective turret containing one or more optical objectives, the improvement comprising:

means for multi-axis force and/or displacement measurement mounted in said objective turret, said means for multi-axis force and/or displacement measurement including:

a precision Multi-dimensional capacitive transducer comprising:

a plurality of drive plates, said drive plates being composed of electrically conductive material;

pickup electrode means movably mounted relative to said drive plates; and

probe tip means for transmitting force and/or displacement between said transducer and a sample.

26. The apparatus of claim 25, further including:

electrical circuit means for applying electrical drive pulses to said drive plates, said drive plates being operatively grouped into pairs, said pulses having a frequency F, and a pulse width T of approximately 1/F divided by the total number of drive plates, said drive pulses being grouped into one main channel per operative drive plate pair, each main channel consisting of two sub-channel

pulses, one sub-channel pulse of said main channel operative on a first drive plate of said drive plate pair, with remaining sub-channel pulse of said main channel simultaneously operative on remaining drive plate of said drive plate pair, with said main channels being multiplexed to sequentially apply said pulses to said drive plates with each main channel dedicated to a particular drive plate pair, and with said main channels being spaced apart in time by approximately the pulse width T;

sampling means for synchronously demodulating and demultiplexing the signal on the pickup electrode means into one channel per drive plate pair, each channel consisting of two sub-channel signals, each channel operatively associated with a particular drive plate pair;

timing means for controlling said sampling means such that each first sub-channel is sampled during the time period that the drive pulse is applied to the corresponding drive plate and each second sub-channel is sampled after the drive pulse corresponding to that drive plate has ended, and before the drive pulse corresponding to the next channel in said multiplexed sequence is applied;

storage means for each sub-channel; and

differential amplifier means to convert each of the sub-channel signal pairs into single main channel signals.

27. The apparatus of claim 26, wherein said main channel signals generated by said differential amplifier means constitutes the outputs of the transducer.

28. The apparatus of claim 26, wherein said plurality of drive plates consists of eight plates, the number of said main channel signals being four, further including:

electrical circuit means summing all four main channel signals together, said summed signal constituting the Z-axis output signal;

electrical circuit means generating the difference of two of said main channels, said difference signal constituting the X-axis output signal;

electrical circuit means generating the difference of the two main channels not used to generate the X-axis output, said difference signal constituting the Y-axis output signal.

29. The apparatus of claim 26, wherein each of said main channel signals generated by said differential amplifier means are connected to feedback circuit means which produce feedback signals which control the amplitude of the drive plate pulses in response to displacement of the pickup electrode means relative to the drive plate electrodes, such that the induced voltage on the pickup electrode means is forced to zero, and the feedback signals generated by said feedback circuit means are proportional to the displacement of the pickup electrode means relative to the drive plate electrodes.

30. The apparatus of claim 29, wherein said feedback signals constitute the outputs of the transducer.

31. The apparatus of claim 29, wherein said plurality of drive plates consists of eight plates, the number of said main channel signals being four, the number of said feedback signals being four, further including:

Electrical circuit means summing all four feedback signals together, said summed signal constituting the Z-axis output of the transducer;

electrical circuit means generating the difference of two of said feedback signals, said difference signal constituting the X-axis output signal of the transducer;

electrical circuit means generating the difference of the two feedback signals not used to generate the X-axis output, said difference signal constituting the Y-axis output signal of the transducer.

32. A method of performing a micro-mechanical test on a sample by means of an optical microscope apparatus having a stage providing X-Y motion, focusing means providing Z-axis motion and a multi-position objective turret containing one or more optical objectives, means for multi-axis force and/or displacement measurement mounted in said objective turret, said means for multi-axis force and/or displacement measurement including a precision Multi-dimensional capacitive transducer comprising: a plurality of drive plates, said drive plates being composed of electrically conductive material; pickup electrode means movably mounted relative to said drive plates; probe tip means for transmitting force and/or displacement between said transducer and a sample, the method comprising the test consisting of the steps of:

placing the sample on the stage,

locating the feature or region to be tested using one or more of the optical objectives,

rotating the turret to engage the precision multi-dimensional capacitive transducer, and

moving the stage and/or focus means to engage the probe tip with the sample and apply the desired force and/or displacement while recording said force and/or displacement.

33. An instrument for providing high resolution tribological properties testing of magnetic recording head/slider/suspension assemblies and a test surface, the instrument comprising:

a precision multi-dimensional capacitive transducer,

a load stem and mounting bar attached to said transducer, said mounting bar being of the proper length to position the head slider being tested directly under the load stem of the transducer when the slider suspension is attached to the mounting bar,

means for moving the test surface relative to the slider in at least one direction in the plane of the test surface,

means for applying a normal force between the slider and the test surface, and

means for recording and/or displaying the normal force and the force in at least on direction in the plane of the test surface.

34. A precision Multi-dimensional capacitive transducer comprising:

at least one drive plate electrode assembly, said assembly including a plurality of drive plates, said drive plates being composed of electrically conductive material, said assembly also including insulating substrate means holding said drive plates of said assembly fixed with respect to each other;

spacer means disposed on said at least one drive plate assembly;

pickup electrode means operatively engaging said at least one drive plate electrode assembly; and

at least one support spring, said spring including a main central section and two ends, a first end proximate to and mechanically engaging and supporting said pickup electrode, remaining end engaged and supported by said spacer means, said remaining end being wider than said main central section, said remaining end section proximate said spacer means extending at least ¼ of the width of said main section, before contacting said spacer means.

35. The transducer of Claim 34 wherein said spacer means and ends proximate said spacer means of said at least one support spring, includes additional support means.

36. A precision Multi-dimension capacitive transducer comprising:

pickup electrode means containing six faces, said faces operatively grouped into three pairs, the two faces within each pair being parallel with each other and the faces of each pair being orthogonal with each of the faces of the other two pair,

all of said faces connected electrically and mechanically together and composed of an electrically conductive material, said pickup electrode means being centrally located within the transducer;

six drive plates, one drive plate facing one of each face of said pickup electrode means, means for supporting said drive plates, each of said drive plates being composed of an electrically conductive material;

a plurality of support springs engaging and supporting said pickup electrode means, said support springs arranged in a three dimensional network effective to restrict motion of said pickup electrode means to the three orthogonal axes normal to the faces of said pickup electrode means.

37. The capacitive transducer of Claim 36, further including: electrical circuit means for applying electrical drive pulses to said drive plates, said pulses having a frequency F, and pulse width T of approximately 1/(6*F), said drive pulses being grouped into three main channels, one per operative drive plate pair, there being a total of three drive plate pairs, each of said pair physically positioned on opposite faces of said pickup electrode means, each main channel consisting of two sub-channel pulses, one sub-channel pulse of said main channel operative on one drive plate of said drive plate pair, with remaining sub-channel pulse of said main channel simultaneously operative on remaining drive plate of said operative drive plate pair, with said main channels being multiplexed to sequentially apply said pulses to said drive plates with each main channel dedicated to a particular operative drive plate pair and with said main channels

being spaced apart in time by approximately the pulse width T;

sampling means for synchronously demodulating and demultiplexing the signal on the pickup electrode means into three channels, each channel consisting of two sub-channel signals, each channel operatively associated with a particular operative drive plate pair;

timing means for controlling said sampling means such that each first sub-channel is sampled during the time period that the drive pulse is applied to the corresponding drive plate and each second sub-channel is sampled after the drive pulse corresponding to that drive plate has ended, and before the drive pulse corresponding to the next channel in said multiplexed sequence is applied;

storage means for each sub-channel; and

differential amplifier means to convert each of the three sub-channel signal pairs into single main channel signals.

39. The capacitive transducer of Claim 37, wherein each of said main channel signals generated by said differential amplifier means are connected to feedback circuit means which produce feedback signals which control the amplitude of the drive plate pulses in response to displacement of the pickup electrode means, such that the induced voltage on the pickup electrode means is forced to zero, and the feedback signals generated by said feedback circuit means are proportional to the displacement of the pickup electrode means.

41. The instrument of claim 33 wherein said test surface comprises a rigid disk of a magnetic disk drive data storage device.

42. The transducer of Claim 36 wherein said pickup electrode means further comprises a hollow box shaped structure.

43. The transducer of Claim 36 wherein said pickup electrode means further comprises three interleaved flat plates.

44. A precision Multi-dimensional capacitive transducer comprising:

pickup electrode means comprising a centrally located center electrode;

a plurality of pairs of drive plates, one of each of said pairs of drive plates being disposed on each of opposing sides of said center electrode, means for supporting each of said drive plates, each of said drive plates being composed of an electrically conductive material;

a plurality of support springs engaging and supporting said center electrode, said support springs comprising planar springs;

electrical circuit means for applying electrical drive pulses to said drive plates, said pulses having a frequency F, and a pulse width T of approximately 1/F divided by the total number of drive plates, said drive pulses being grouped into one main channel per operative upper/lower drive plate pair, each main channel consisting of two sub-channel pulses, one sub-channel pulse operative on each

drive plate, with said main channels being multiplexed to sequentially apply said pulses to said drive plates with said main channels being spaced apart in time by approximately the pulse width T, and said two sub-channel signals of the active main channel being applied simultaneously to the top/bottom drive plate pair;

sampling means for synchronously demodulating and demultiplexing the signal on the pickup plate into one channel per drive plate pair, each channel consisting of two sub-channel signals;

timing means for controlling said sampling means such that each first sub-channel is sampled during the time period that the drive pulse is applied to the corresponding drive plate and each second sub-channel is sampled after the drive pulse corresponding to that drive plate has ended, and before the drive pulse corresponding to the next channel is applied;

storage means for each sub-channel; and

differential amplifier means to convert each of the sub-channel signal pairs into single main channel signals.

45. A precision multi-dimensional capacitive transducer comprising:

a lower drive plate electrode assembly, said lower assembly including a plurality of drive plates, said drive plates being composed of electrically conductive material;

an upper drive plate electrode assembly, said upper assembly including a plurality of drive plates, said drive plates being composed of electrically conductive material;

pickup electrode means comprising a center electrode assembly including a center

electrode and a plurality of support springs engaging and supporting said center electrode, said support springs comprising planar springs;

said lower drive plate electrode assembly and said upper drive plate electrode assembly being disposed on opposing sides of said center electrode;

electrical circuit means for applying electrical drive pulses to said drive plates, said pulses having a frequency F, and a pulse width T of approximately 1/F divided by the total number of drive plates, said drive pulses being grouped into one main channel per operative upper/lower drive plate pair, each main channel consisting of two sub-channel pulses, one sub-channel pulse operative on each drive plate, with said main channels being multiplexed to sequentially apply said pulses to said drive plates with said main channels being spaced apart in time by approximately the pulse width T, and said two sub-channel signals of the active main channel being applied simultaneously to the top/bottom drive plate pair;

sampling means for synchronously demodulating and demultiplexing the signal on the pickup plate into one channel per drive plate pair, each channel consisting of two sub-channel signals;

timing means for controlling said sampling means such that each first sub-channel is sampled during the time period that the drive pulse is applied to the corresponding drive plate and each second sub-channel is sampled after the drive pulse corresponding to that drive plate has ended, and before the drive pulse corresponding to the next channel is applied;

storage means for each sub-channel; and

differential amplifier means to convert each of the sub-channel signal pairs into single main channel signals.

46. The capacitive transducer of Claim 19, wherein said pickup electrode means comprises a centrally located center electrode, with said drive plates comprising two groups disposed on opposing sides of said center electrode.

47. The capacitive transducer of Claim 46, wherein said main channel signals generated by said differential amplifier means constitutes the outputs of the transducer.

48. The capacitive transducer of Claim 46, wherein said drive plate electrodes comprise eight plates, with said two groups of drive plate electrodes comprising four plates each, further comprising:

electrical circuit means summing all four main channel signals together, said summed signal constituting the Z-axis output signal;

electrical circuit means generating the difference of two of said main channels, said difference signal constituting the X-axis output signal; and

electrical circuit means generating the difference of the two main channel signals not used to generate the X-axis output, said difference signal constituting the Y-axis output signal.

49. The capacitive transducer of Claim 46, wherein each of said main channel

signals generated by said differential amplifier means are connected to feedback circuit means which produce feedback signals which control the amplitude of the drive plate pulses in response to displacement of the pickup electrode means relative to the drive plate electrodes, such that the induced voltage on the pickup electrode means is forced to zero, and the feedback signals generated by said feedback circuit means are proportional to the displacement of the pickup electrode means relative to the drive plate electrodes.

50. The capacitive transducer of Claim 49, wherein said feedback signals constitute the outputs of the transducer.

51. The capacitive transducer of Claim 49, wherein said drive plate electrodes comprise eight plates, with said two groups of drive plate electrodes comprising four plates each, further comprising:

electrical circuit means summing all four feedback signals together, said summed signal constituting the Z-axis output signal;

electrical circuit means generating the difference of two of said feedback signals, said difference signal constituting the X-axis output signal; and

electrical circuit means generating the difference of the two feedback signals not used to generate the X-axis output, said difference signal constituting the Y-axis output signal.

52. The transducer of Claim 34, wherein said insulating substrate means of said at least one drive plate electrode assembly is composed of aluminum oxide.

53. The transducer of Claim 52, wherein the at least one support spring is composed of a material having a thermal expansion coefficient similar to aluminum oxide.

54. The transducer of Claim 53, wherein the at least one support spring is composed of molybdenum metal.

55. The transducer of Claim 35, wherein said insulating substrate means of said at least one drive plate electrode assembly is composed of aluminum oxide.

56. The transducer of Claim 55, wherein the at least one support spring and said spacer means are composed of a material having a thermal expansion coefficient similar to aluminum oxide.

57. The transducer of Claim 56, wherein the at least one support spring and said spacer means are composed of molybdenum metal.